



MathWorks 

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Share the EXPO experience

#MATLABEXPO

Welcome to this session!

Tell us about you!



MATLAB EXPO

Preparing Engineers for the Growing AI Workforce

Gaby Arellano-Bello, MathWorks



Maria E. Gavilan-Alfonso, MathWorks







Company “Administrador del Mercado Mayorista” Develops AI-Based Models for Predicting Electricity Demand



Challenge

Forecast electricity demand across Guatemala to increase grid stability, maximize power generated from renewable resources, and lower energy costs

Solution

Use MATLAB to develop machine learning and deep learning algorithms that use historical load measurements, outside temperatures, and other data to predict hour-by-hour demand

Results

- Prediction error halved
- Models updated rapidly for pandemic-related changes
- Production tool developed and deployed in 6 months



Demand prediction tool.

“Before starting this project, we had no experience with AI and little experience with programming in MATLAB. Machine learning and deep learning are complex topics, but MATLAB made the project straightforward for us with toolboxes that are easy to learn and use.”

- Lead engineer, Administrador del Mercado Mayorista

Key Industries



Aerospace and Defense



Automotive



Biological Sciences



Biotech and Pharmaceutical



Communications



Electronics



Energy Production



Financial Services



Industrial Machinery



Medical Devices



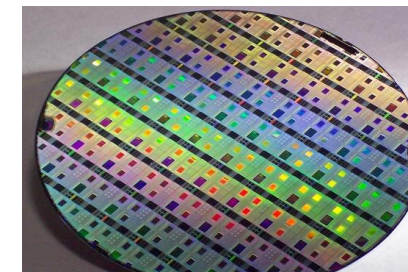
Metals, Materials, Mining



Neuroscience



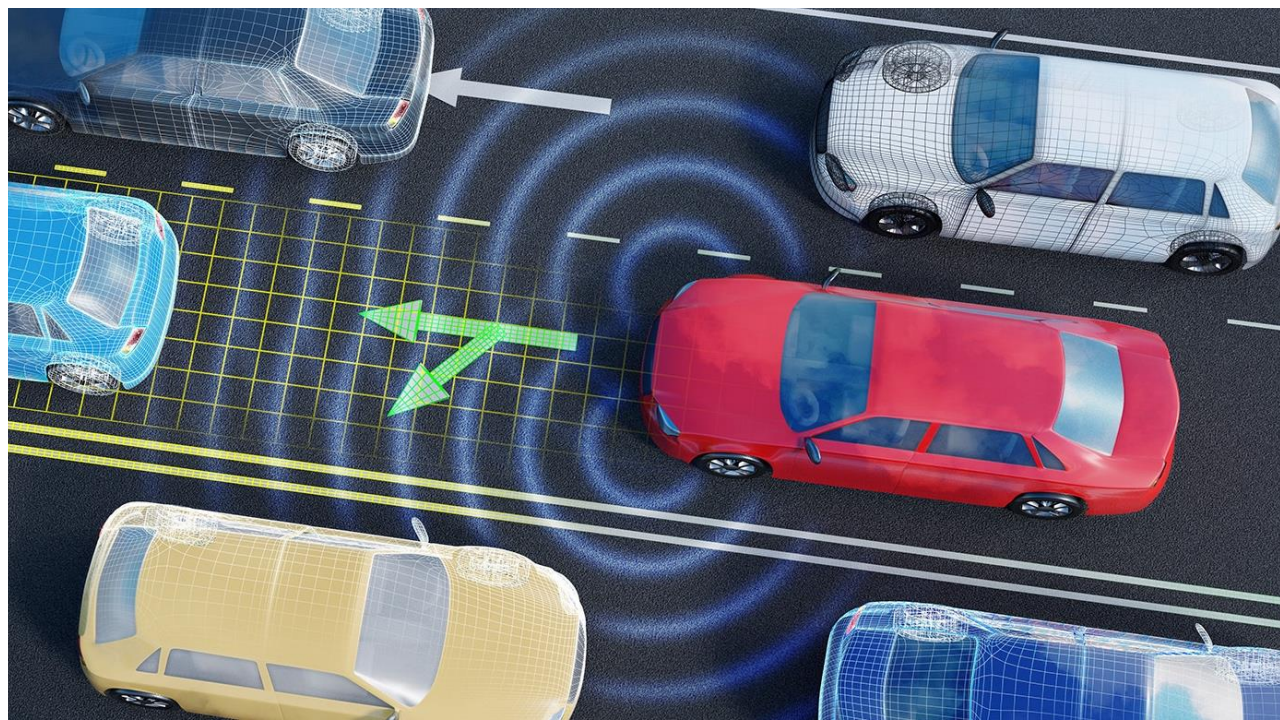
Railway Systems



Semiconductors



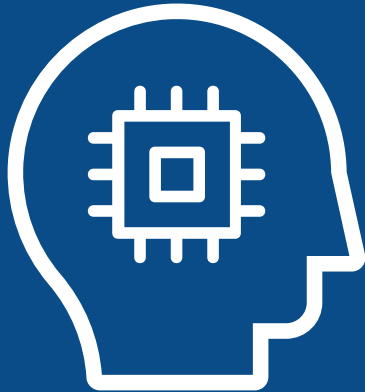
Software and Internet



AI megatrend

ARTIFICIAL INTELLIGENCE

Any technique that enables machines to mimic human intelligence



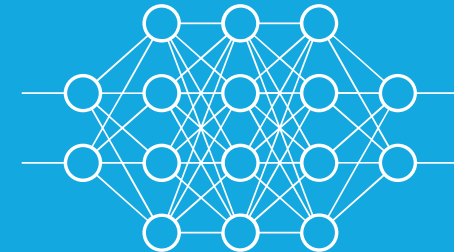
MACHINE LEARNING

Statistical methods that enable machines to “learn” tasks from data without explicitly programming



DEEP LEARNING

Neural networks with many layers that learn representations and tasks “directly” from data



1950s

1980s

2010s

MATLAB® & SIMULINK®



MathWorks is your AI partner



Your People

Helping you build an agile workforce today and preparing tomorrow's engineers



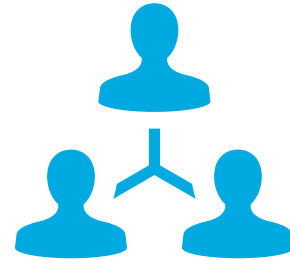
The Platform

MATLAB, Simulink, and over 100 add-on products for specialized applications



Our Expertise

From onboarding and implementation to solving advanced engineering challenges

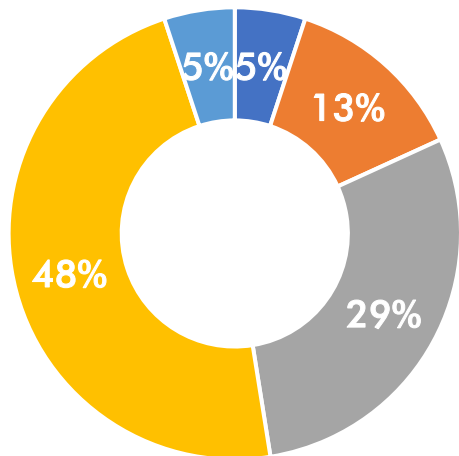


What are the gaps between the skills of new engineers and what the industry requires?

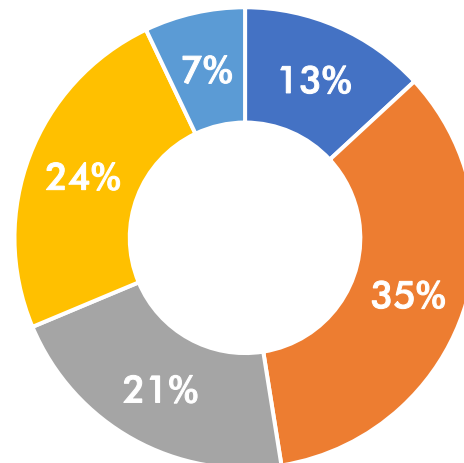
Technical Skills – Existing gaps

According to the Survey for Skills Gaps in Recent Engineering Graduates (ASEE, 2020):

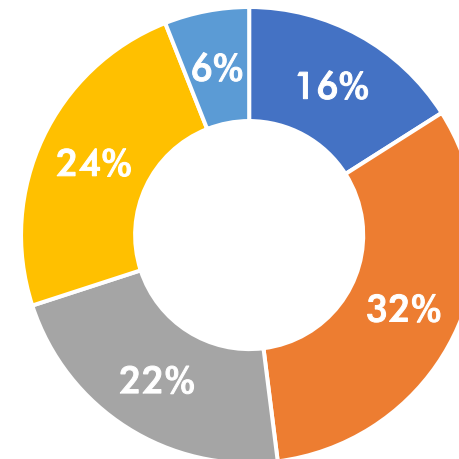
Artificial Intelligence



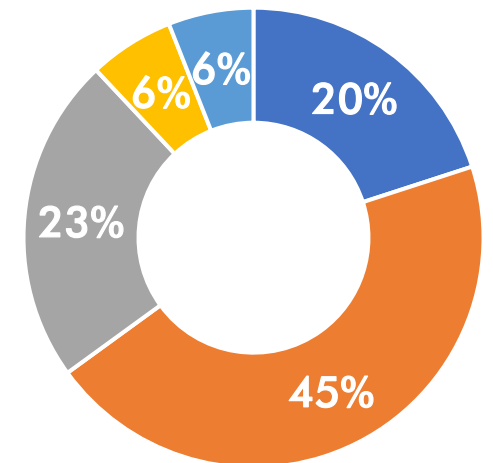
Simulation



Model-Based Systems Engineering



Systems Integration and Systems Thinking



■ Very prepared ■ Somewhat prepared ■ Very little preparation ■ Not prepared at all ■ Gained skill after graduation



Teaching AI + X

Audio Processing

Signal Processing

Image Processing

Biomedicine

Robotics

...

Lecture

- 1 – 2 classes
- Overview on theory
- Domain-specific applications

Pre-work

- Readings
- Self-paced courses

Assignment

- **[Problem]** Continue problem from class on MATLAB Online
- **[Guided project]** Work on examples of AI problems in the course domain

Deep Learning + Image Processing

Image denoising using deep learning

(C) Oge Marques, PhD - 2020

Goal: Build and evaluate image denoising solutions using deep learning architectures.

Learning objectives:

- Learn how to implement an image denoising workflow in MATLAB
- Learn how to implement and evaluate contemporary (deep-learning-based) image denoising techniques in MATLAB
- Get acquainted with representative datasets and problems in image denoising

Table of Contents

- Part 1: Noise type
- Effects of different noise types
- Assess different denoising methods
- Your turn (step 1 of the guidelines)
- Part 2: Denoising
- Your turn (step 2 of the guidelines)
- Your turn (step 3 of the guidelines)
- Part 3: Training your own network
- Your turn (step 4 of the guidelines)
- Part 4: (OPTIONAL) Your turn (step 5 of the guidelines)
- Your turn (step 6 of the guidelines)
- Your turn (step 7 of the guidelines)

Part 1: Noise

Effects of different noise types
`imnoise()` allows you to add different types of noise to an image.

Semantic image segmentation using deep learning

(C) Oge Marques, PhD - 2020

Goal: Build and evaluate semantic image segmentation solutions using deep learning architectures.

Learning objectives:

- Learn how to implement an image segmentation workflow in MATLAB
- Learn how to implement and evaluate contemporary (deep-learning-based) semantic image segmentation techniques in MATLAB
- Get acquainted with representative datasets and problems in image segmentation

Table of Contents

Part 1: Semantic image segmentation creating and training your own network

Example code

- Step 1.1: Collect labeled training data (triangles)
- Step 1.2: Create a semantic segmentation network and understand what each (group of) layer(s) is doing
- Step 1.3: Train network
- Step 1.4: Evaluate results visually (displaying a test image and overlaying predicted labels)
- Step 1.5: Evaluate results quantitatively using different metrics (class accuracy, IoU)
- Your turn (step 5 of the guidelines)
- (OPTIONAL) Your turn (step 6 of the guidelines)
- (OPTIONAL) Your turn (step 7 of the guidelines)

Part 2: Semantic image segmentation using a pretrained network

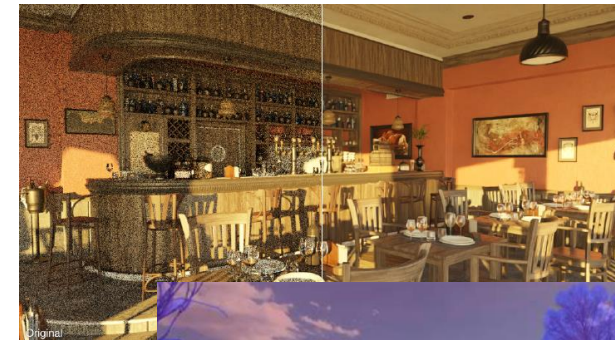
Example code

- Step 2.1: Get the labeled data (CamVid dataset).
- Step 2.2: Explore, understand, and prepare the data.
- Step 2.3: Create network.
- Step 2.4: Train network
- Step 2.5: Evaluate results visually (displaying a test image and overlaying predicted labels)
- Step 2.6: Evaluate results quantitatively using different metrics (class accuracy, IoU)
- Step 2.7: (OPTIONAL) Repeat steps 7 through 14 using different pretrained networks, training options, data augmentation options, and/or metrics.

Supporting Functions



Deep Learning Onramp



In collaboration with
Dr. Oge Marques

“Everyone who comes in as a new hire already knows MATLAB, because they all had it in college. The learning curve is significantly lessened as a result.”

Jeff Corn, Chief of Engineering Projects Section
U.S. Air Force



MathWorks is building the AI workforce of tomorrow

MATLAB and Simulink are the tools of inspiration and innovation used by students, educators, and researchers around the world.



6500+

colleges and universities
teach with our software



1+ million

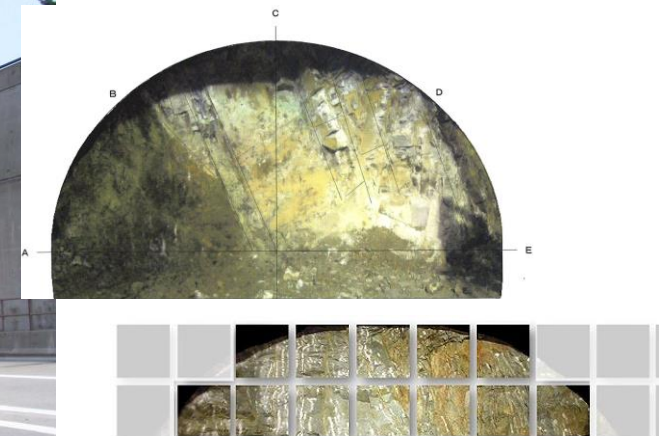
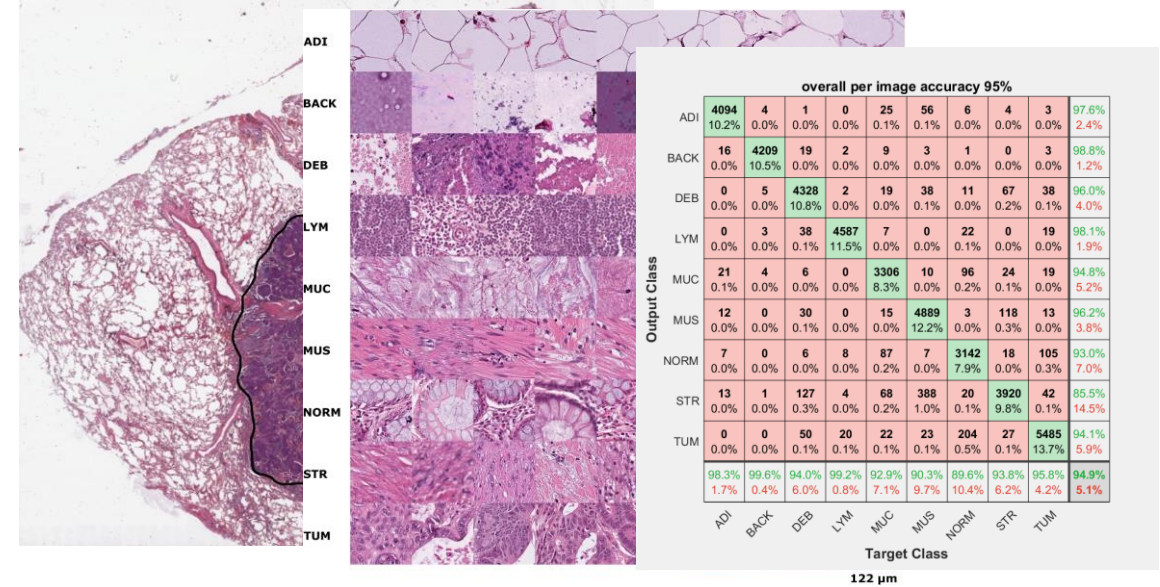
enrollments in online courses
and trainings each year



Tens of Thousands

of skilled graduates enter the
workforce each year

Today, we see AI applications in all fields of engineering



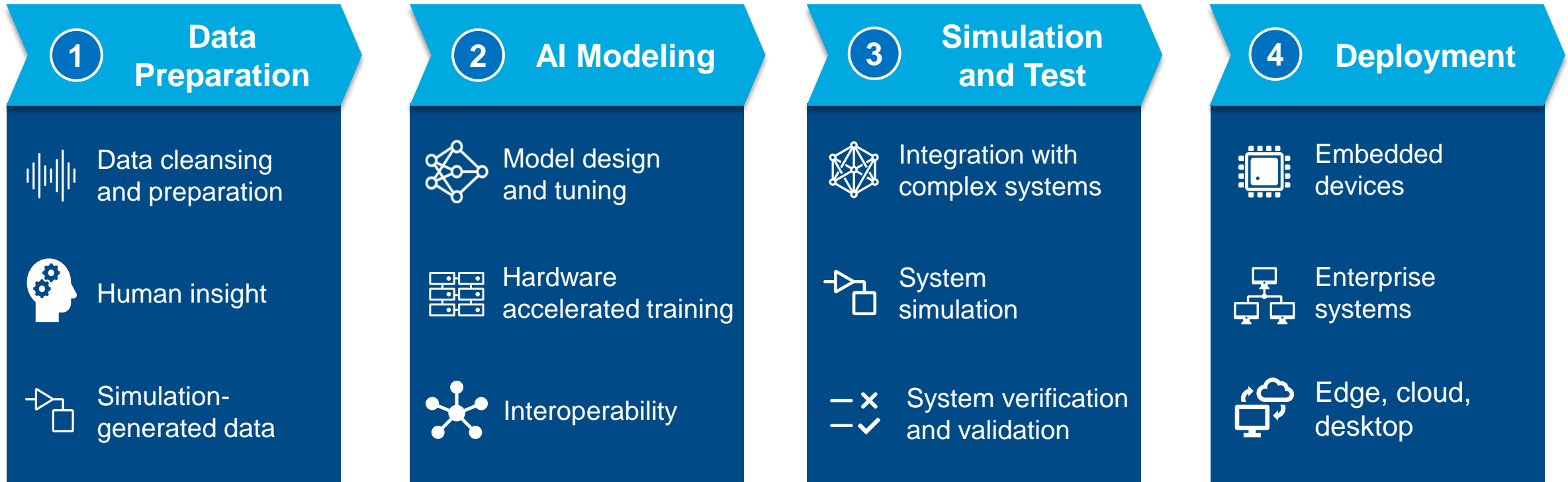


AI is more than just a model...

Success with AI requires more than data and training an AI model. You need high-quality data, staff with skills for AI work, and an end-to-end AI workflow. **Start with the workflow.**



AI is more than just a model...



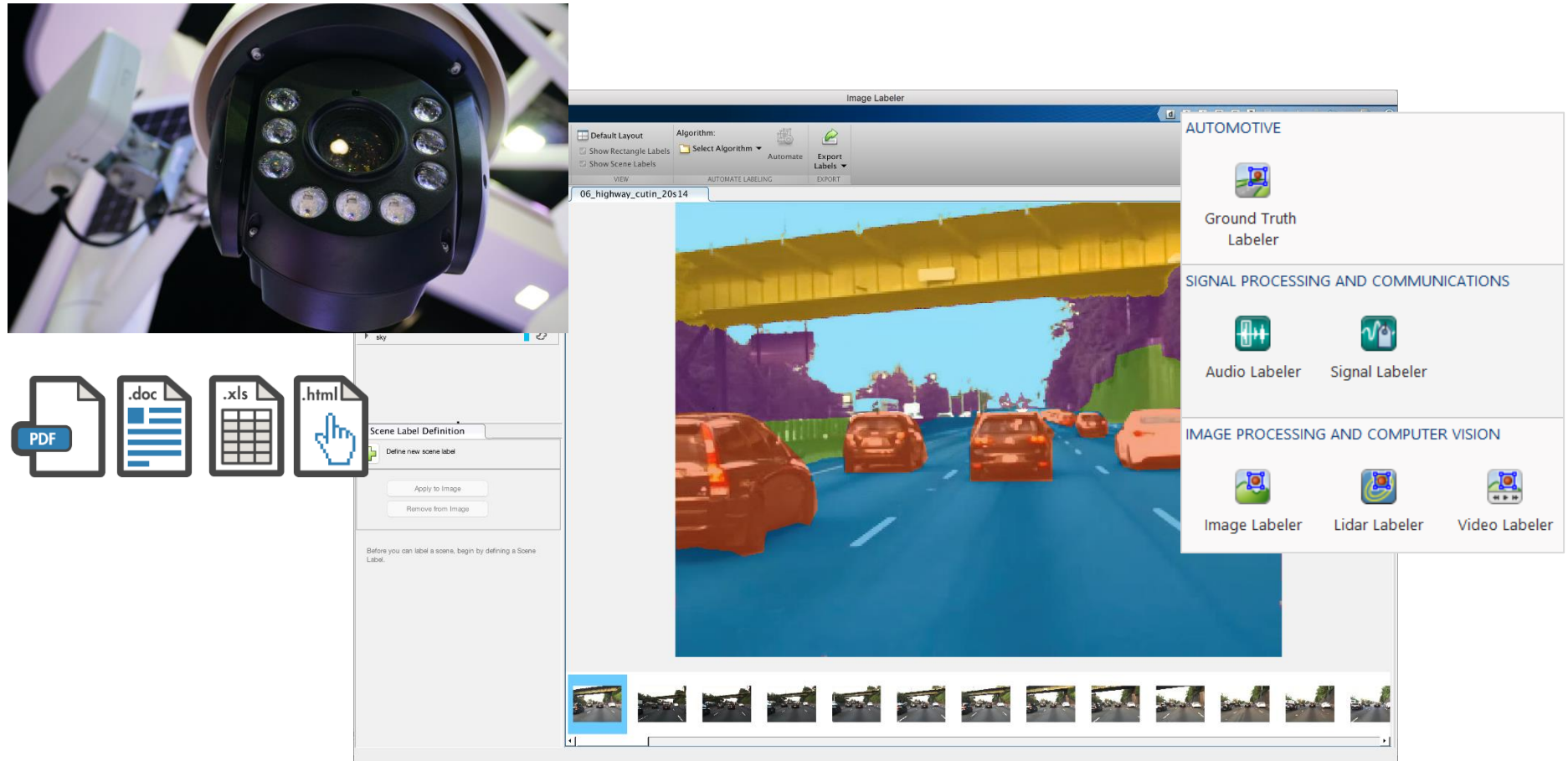
Data preparation is crucial for the success of AI

1 Data Preparation

2 AI Modeling

3 Simulation and test

4 Deployment



Use labeling apps for deep learning workflows like semantic segmentation

Start with a complete set of algorithms, examples and apps

Algorithms

Machine learning
Deep learning
Reinforcement learning
Regression
Unsupervised learning
Predictive maintenance
Bayesian optimization

Reference examples

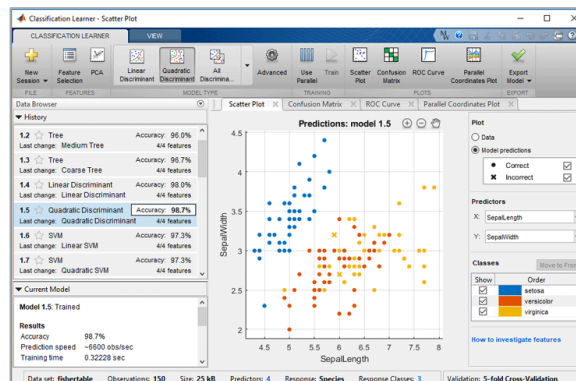
Object detection: Vehicles, pedestrians, faces...
Semantic segmentation: Roadway detection, land cover classification, tumor detection...
Signal and speech processing: Denoising, music genre recognition, keyword spotting, radar waveform classification...
...and more...

1 Data Preparation

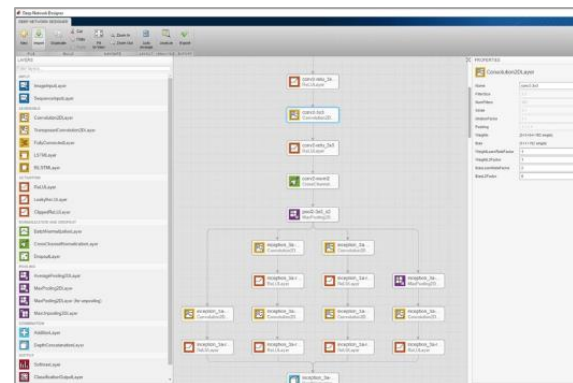
2 AI Modeling

3 Simulation and test

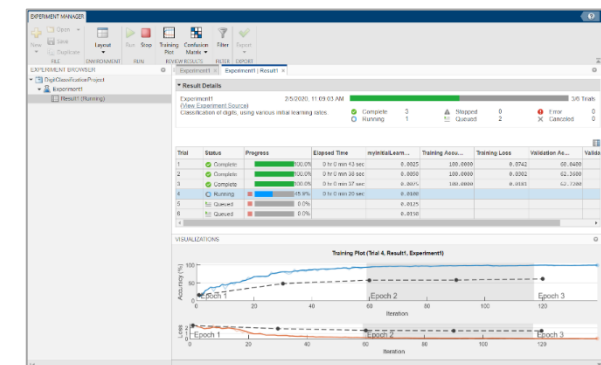
4 Deployment



Classification Learner app to try different classifiers and find the best fit for data sets.

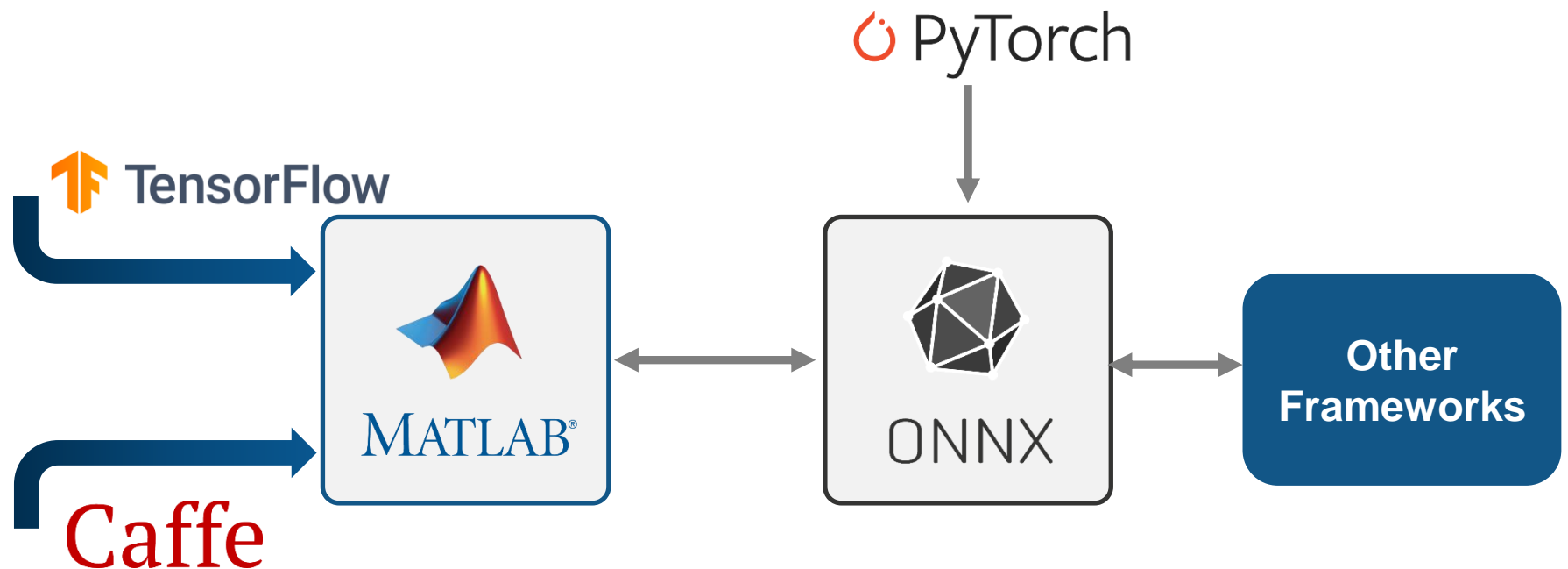


Deep Network Designer app to build, visualize, and edit deep learning networks.



Experiment Manager app to run deep learning experiments to train networks and compare results.

MATLAB interoperates with other AI frameworks



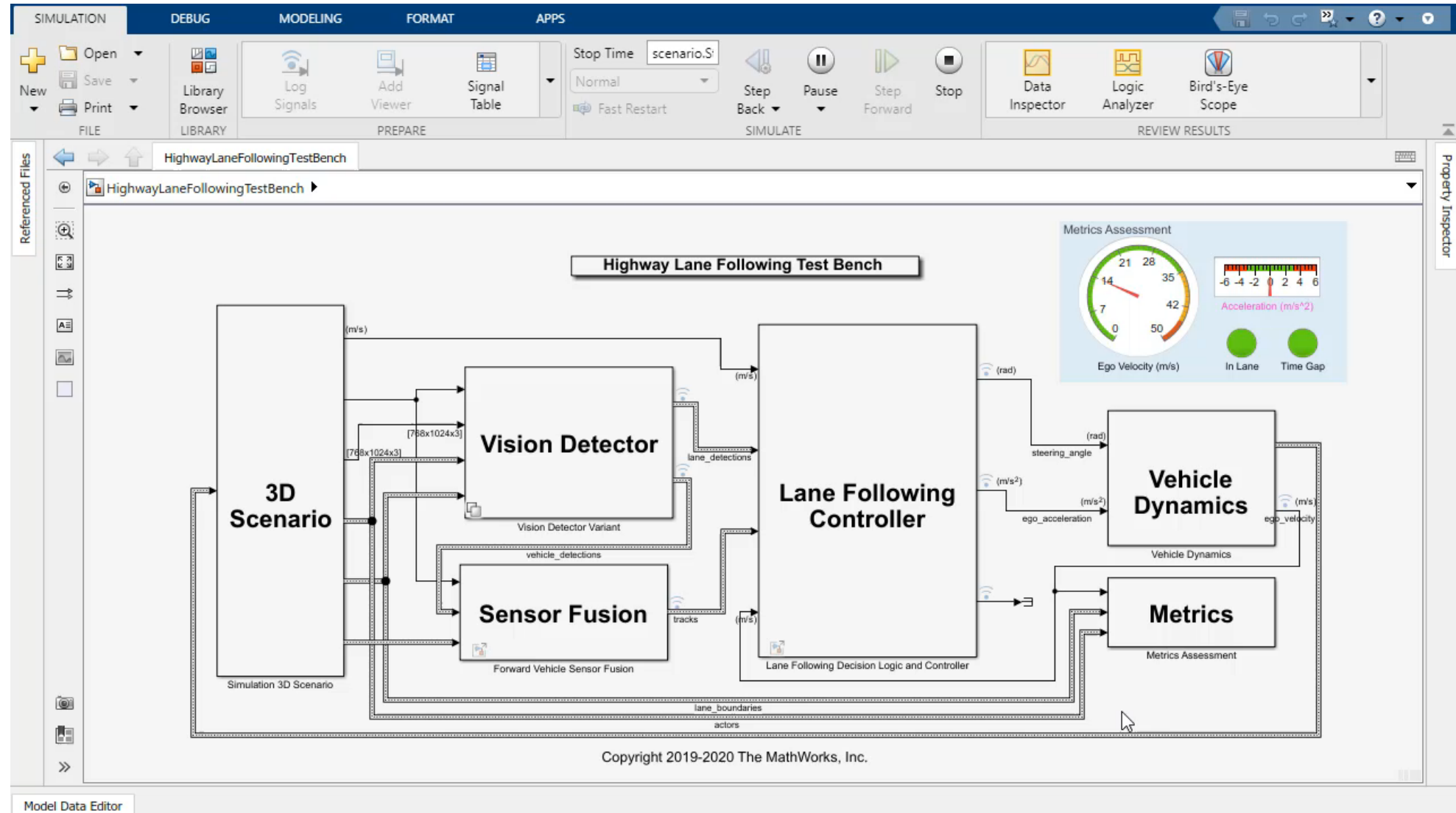
Complex, AI-driven systems require integration and simulation

1 Data Preparation

2 AI Modeling

3 Simulation and Test

4 Deployment



AI Models need to be deployed anywhere...

1 Data Preparation

2 AI Modeling

3 Simulation and test

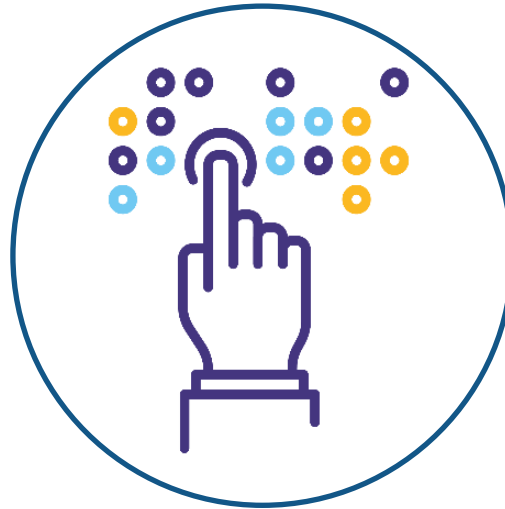
4 Deployment



Now that we covered the process, how can we familiarize our students and engineers with these concepts?



**Course
material**



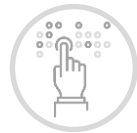
**Self-paced
learning**



Projects



Course material



Self-paced
learning



Projects

MATLAB EXPO

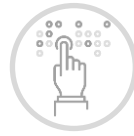
Books and Courseware in Artificial Intelligence



<https://www.mathworks.com/academia/books.html>



Course material

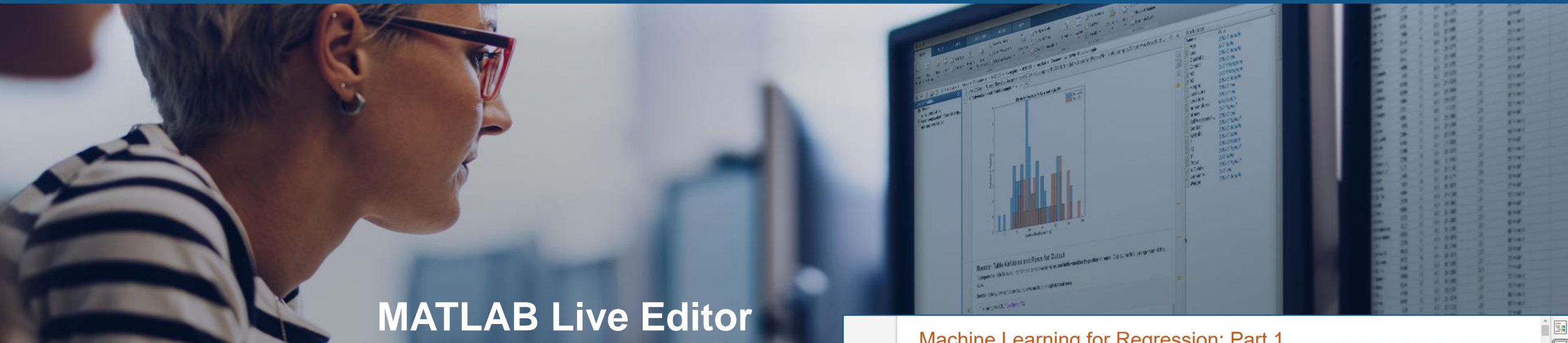


Self-paced
learning



Projects

MATLAB EXPO



MATLAB Live Editor



Create **engaging lectures**



Share live scripts directly with colleagues or students



Work in a **single environment** to eliminate context switching

Machine Learning for Regression: Part 1

A light introduction

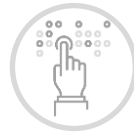
Table of Contents

- What is Machine Learning?
- Feature Engineering
- Some Machine Learning Models
 - Linear Regression
 - Stepwise Linear Regression
 - Regression Tree
 - Ensemble of Trees
- Validating and Testing
 - Overfitting and Underfitting
 - Model Evaluation
- Further Exploration
- Helper Functions

Suggested Prework



Course material



Self-paced
learning



Projects

MATLAB EXPO

MATLAB Grader

CONTENTS

Close

A Practical Machine Learning Demo Course

Reorder Content

Find natural trends

Classification

Regression

ADD ASSIGNMENT

Manage People

Courses & Content

LMS Integration

Documentation & Support

A Practical Machine Learning Demo Course

Edit Actions

Duration (UTC): 23 Jun 2020 - 31 Aug 2020

Products:
Deep Learning Toolbox, Statistics and Machine Learning Toolbox

Course Description

Syllabus

Further reading

1. Introduction

2. Finding natural trends

3. Classification

4. Regression

5. Shallow neural networks

<https://www.mathworks.com/solutions/machine-learning.html>

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Create interactive course assignments



Automatically grade student work and
provide feedback



Run your assignments in any learning
environment

<https://www.mathworks.com/products/matlab-grader.html>



Course material

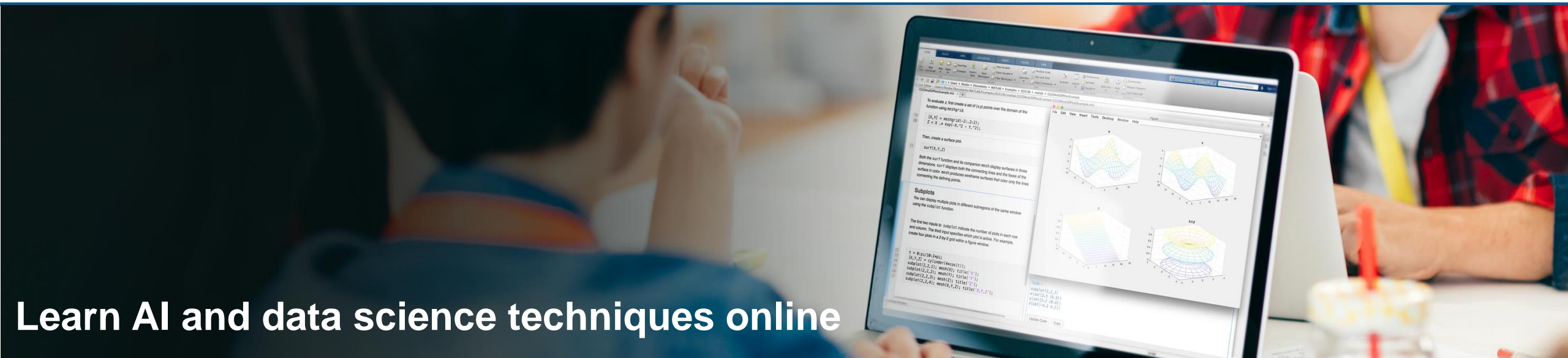


Self-paced
learning




Projects


MATLAB EXPO



Learn AI and data science techniques online



**Machine Learning
Onramp**



**Deep Learning
Onramp**



**Reinforcement
Learning Onramp**



Course material

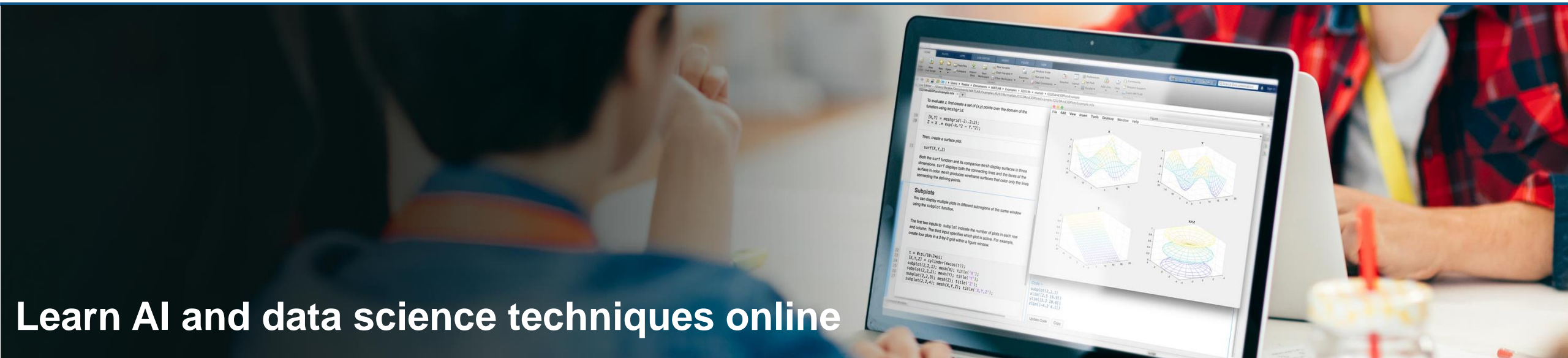


Self-paced
learning



Projects

MATLAB EXPO



Learn AI and data science techniques online

coursera

**Practical Data Science with
MATLAB Specialization**

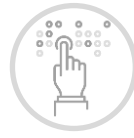
Offered By



<https://www.coursera.org/specializations/practical-data-science-matlab>



Course material



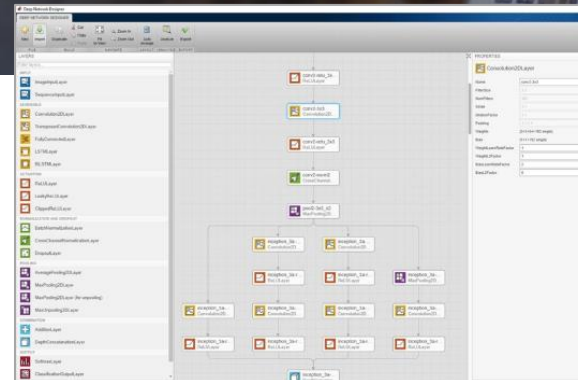
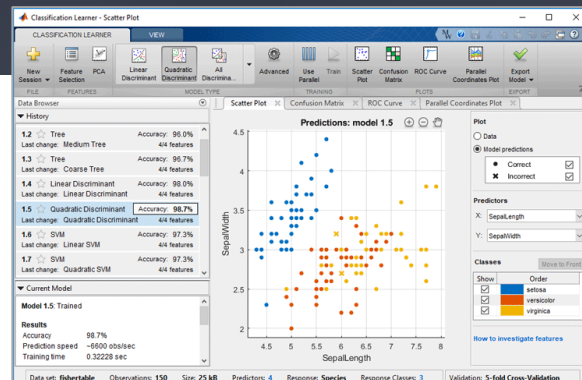
Self-paced
learning



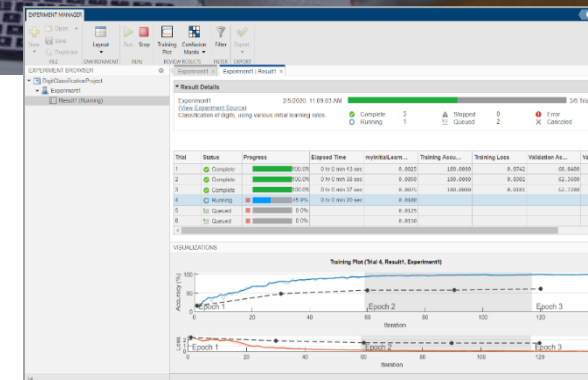
Projects

MATLAB EXPO

Apps empower students to
solve complex projects



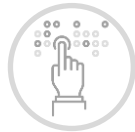
Deep Network Designer build, visualize, and edit deep learning networks.



<https://www.mathworks.com/discovery/matlab-apps.html>



Course material



Self-paced
learning



Projects

MATLAB EXPO



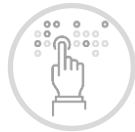
Build AI-enabled systems

- Treat engineering students like engineers with real projects
- Easy-to-learn syntax and block diagrams
- Increase student interest and improve learning

<https://www.mathworks.com/hardware-support/home.html>



Course material



Self-paced
learning



Projects

MATLAB EXPO

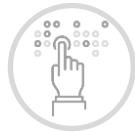


MATHWORKS **EXCELLENCE IN INNOVATION**

- Learn about Industry trends
- Solve a project of real industry relevance
- Contribute to the advancement of technical computing and Model-Based Design
- Gain official recognition for your problem-solving skills from technology leaders

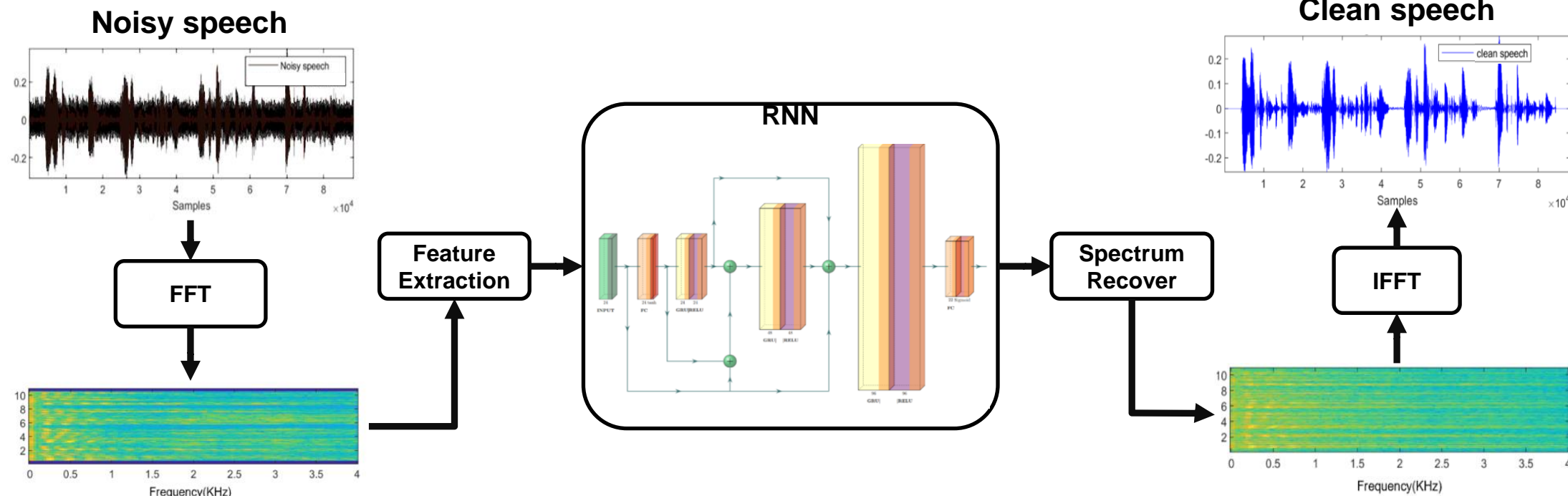


<https://github.com/mathworks/MathWorks-Excellence-in-Innovation>



Speech Background Noise Suppression with Deep Learning

- **Project:** Develop a deep learning neural network for audio background noise suppression
- **Student solution:** Adopt a Recurrent Neural Network following the RNNoise structure



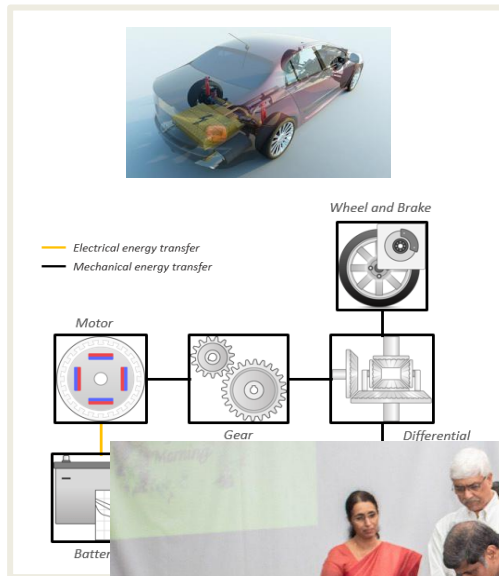
Engineering Education, Research and Industry

“The EVSE course I took in my final year of BTech was a turning point in my understanding of the world of engineering.”



—Hari Bhaskar, Bosch Global Software Technologies and Graduate of NIT Calicut

Knowledge Curricula

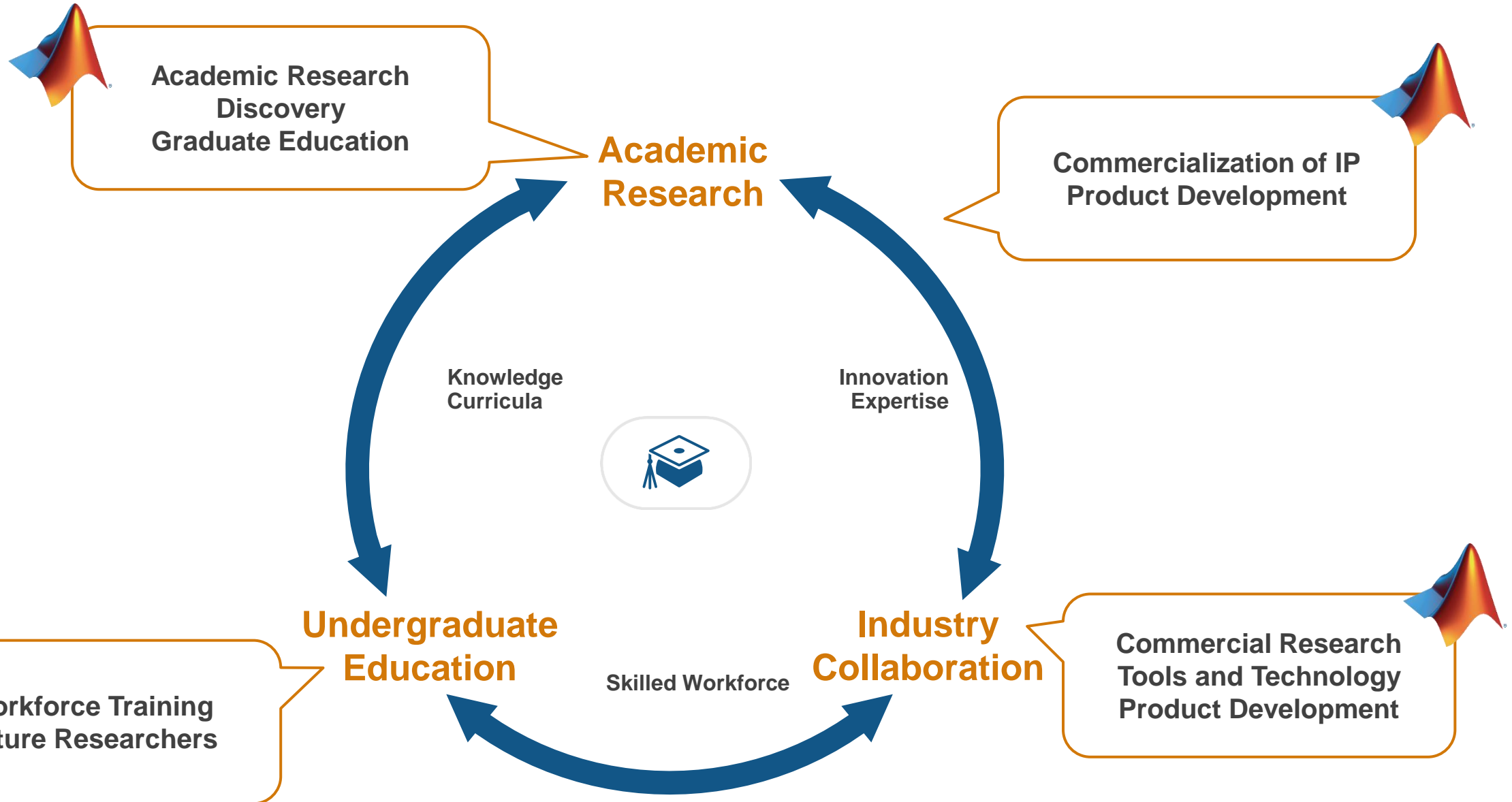


Skilled Workforce



BOSCH

AI in Engineering Education, Research and Industry



AI in Engineering Education, Research and Industry

Advancing AI and Data
Science Through
Industry/Academia
Collaboration

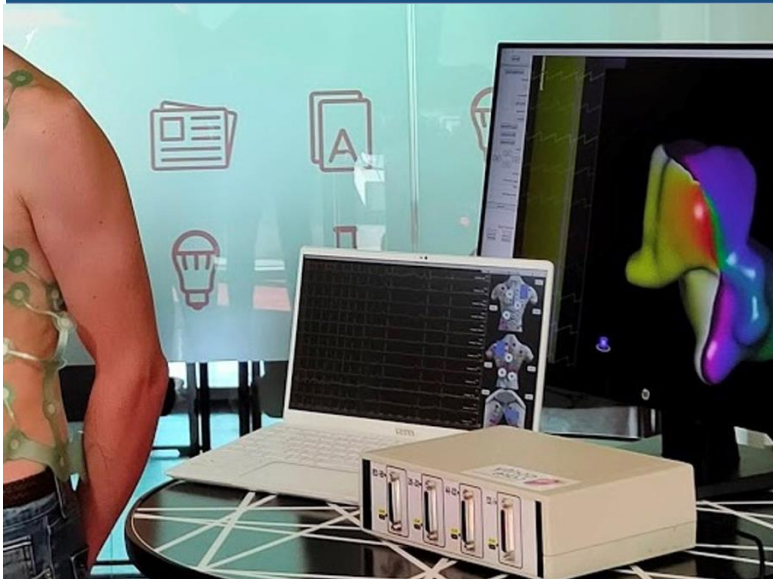
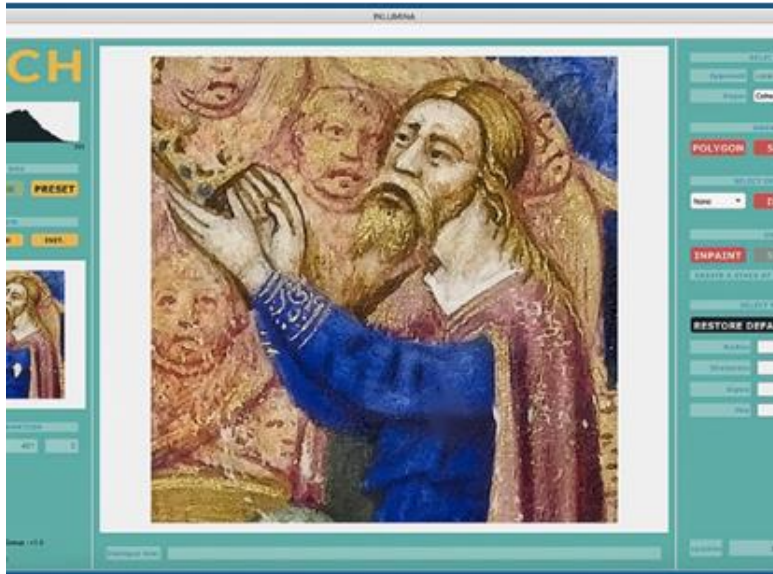


Workforce Training
Future Researchers

Skilled Workforce

Tools and Technology
Product Development

We can make a positive impact on society with AI





MathWorks ✓

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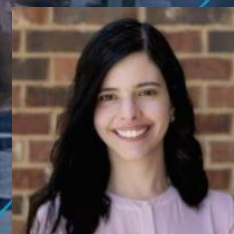
Share the EXPO experience

#MATLABEXPO

Next Steps

1. Explore our website: mathworks.com
2. Explore Education Resources available
3. Interact with the community via MATLAB Central

Let's stay in touch!



Gaby Arellano Bello



gabyarellanobello



@GabyArellanoB



Maria E. Gavilan Alfonso



mariagavilan



@MariaEGavilanA



MATLAB EXPO

Thank you



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